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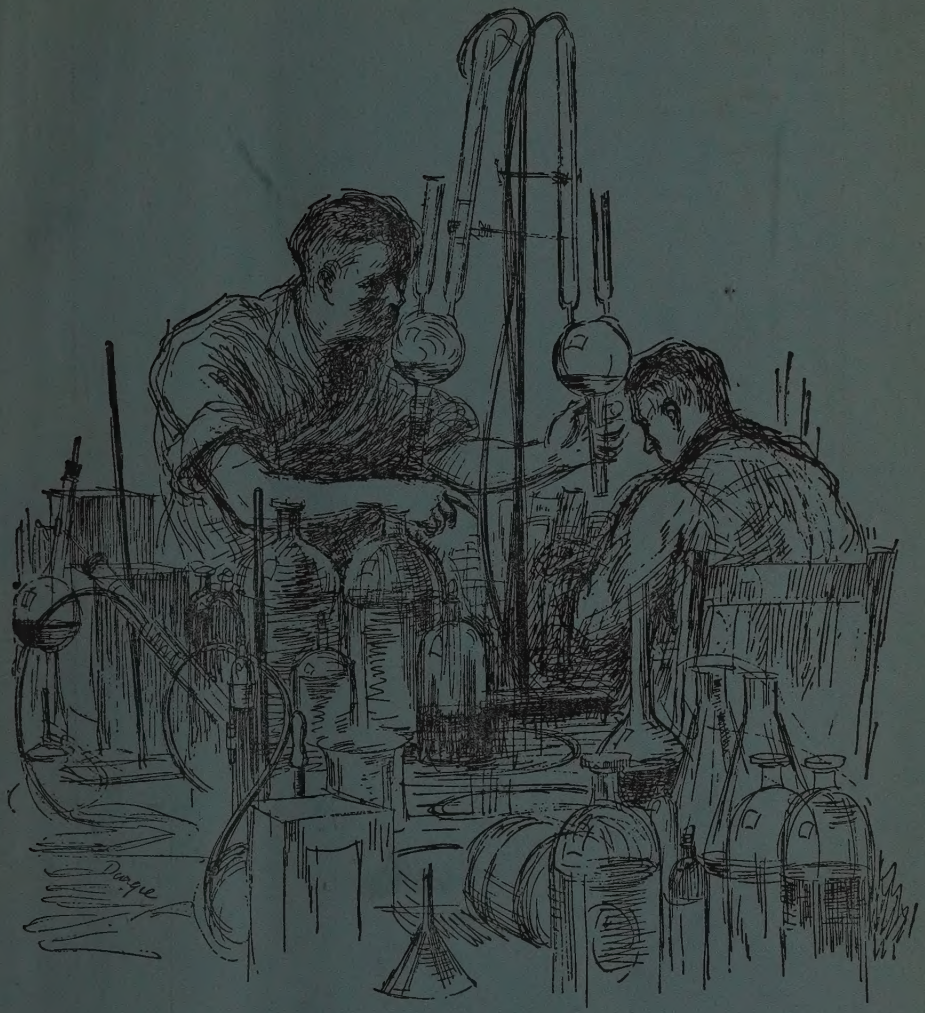

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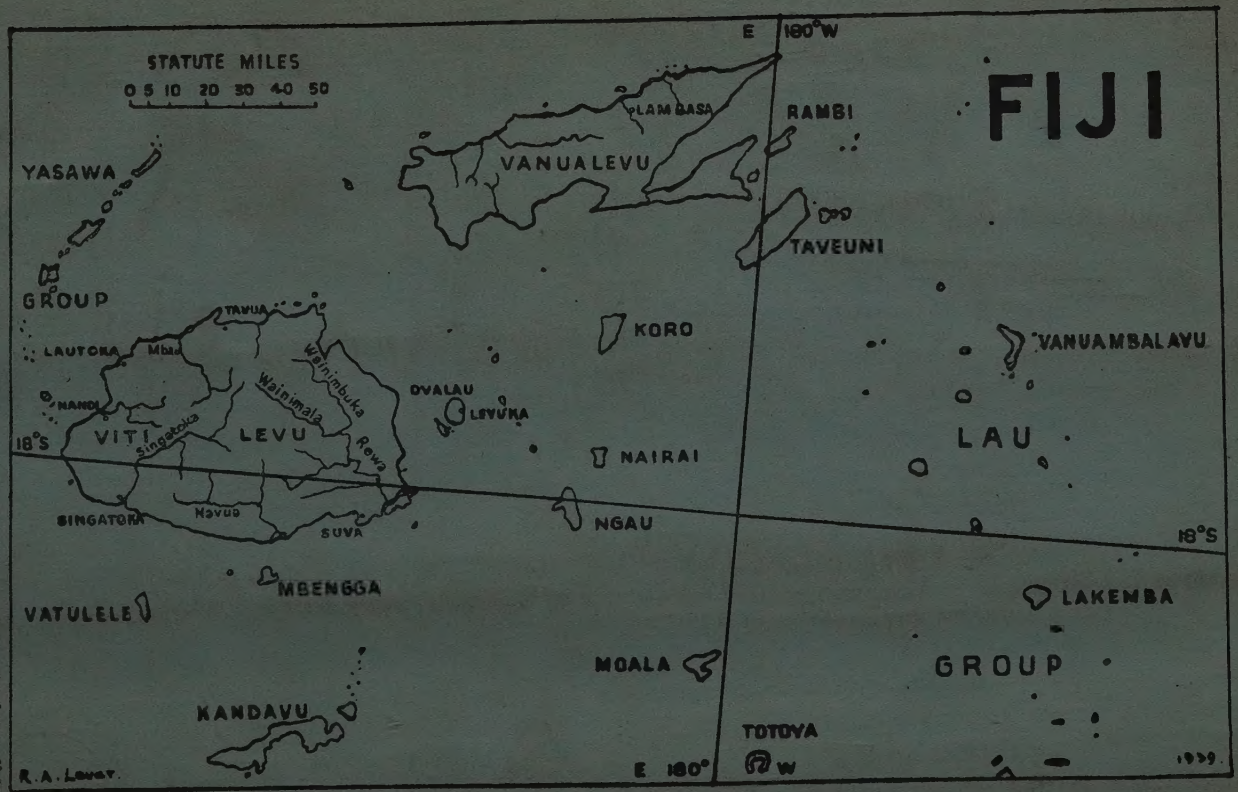

So as to include Kadavu and Totoya within the framework available the map has been rotated some 6° to the east.

VOL. 22 NO. 1 SEPTEMBER, 1951

COLONY OF FIJI

AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI

PRICE : THREE SHILLINGS.

GOVERNMENT PRESS, SUVA, FIJI

Notes for Libraries and Research Institutes.

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So many requests are received from abroad for parts of the *Agricultural Journal* which were never published that the following list of all issues published and those which are not now available is given for reference. Attention is especially directed to Volume 7 which had only one part:—

Vol.				*Vol.*			
1.	3	numbers,	1928.	11.	4	numbers,	1940 (none).
2.	4	,,	1929.	12.	4	,,	1941 (none of Nos. 1 and 2).
3.	3	,,	1930 (none).				
4.	4	,,	1931.	13.	4	,,	1942.
5.	2	,,	1932 (none of No. 2).	14.	4	,,	1943.
6.	2	,,	1933.	15.	4	,,	1944.
7.	1	,,	1934.	16.	4	,,	1945.
8.	4	,,	1935–37 (none of No. 4).	17.	4	,,	1946 (none of No. 1).
9.	4	,,	1938 (none of Nos. 2, 3 and 4).	18.	4	,,	1947 (none of No. 1).
				19.	4	,,	1948 (Nos. 3 & 4 form a double issue.)
10.	4	,,	1939 (none of Nos. 2 and 4).	20.	4	,,	1949.

ISSUES OF THE AGRICULTURAL CIRCULAR.

NUMBERS and year of issue of the *Agricultural Circular* :—

Vol.	1,	1920,	12 numbers.	Vol.	4,	1923,	1 number.
	2,	1921,	5 ,,		5,	1924–5,	2 numbers.
	3,	1922,	4 ,,				

As number 4 of Vol. 3 was printed as " Volume 4 " and number 1 of Vol. 4 as " Volume 5 " it would appear from an inspection of a complete set that Volume 4 comprised only a number 4 and that there were two issues of Volume 5, No. 1.

ANNUAL BULLETINS.

THE Annual Bulletin of Divisional Reports ran from 1931 to 1938 and was then discontinued.

OLD ISSUES OF AGRICULTURAL BULLETINS.

FREE copies of the following Bulletins are available to Colonial Departments of Agriculture research institutes and bona fide planters within the Colony.

No. 1. Sisal Hemp in Fiji, 1911.
3. Rhinoceros Beetle in Samoa, 1912.
4. The Banana in Fiji, 1912.
5. Scale Insect on Bananas, 1913.
6. Lemon Grass, 1913.
7. A Mission to Java for a Coleopterous Pest of Bananas, 1914.
8. Coconut Experiments, 1915.
9. Soils of Fiji—I, 1916.
11. Alluvial Soils of Fiji, 1918.
12. Leaf Moth of Coconuts, 1919.
13. Sea Island Cotton, 1920.
14. Transparent Coconut Scale, 1921.
15. Purple Leaf Moth of Coconuts, 1924.
18. Control of Coconut Spike Moth, 1935.

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No. 21. Biological Control of the Rhinoceros Beetle, 1941. Price 1s.
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22. An introduction to the Mosquitoes of Fiji, 1943. Price 1s.
23. Insect Pests in Fiji, 1946. Price 1s.
Gardening Notes, Insect Pest Control and Plant Diseases, 1945. Price 1s.
24. The Botanical Gardens, Suva, 1948. Price 1s. 6d.

Applications should be made to the Librarian, Department of Agriculture, Suva, Fiji.

—EDITOR.

Agricultural Journal

VOL. 22 SEPTEMBER, 1951 NO. 1

CONTENTS

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EDITORIAL . . .

LIVESTOCK AND THE LAND

In this issue we publish a series of talks on animal production in Fiji which were presented on the occasion of a meeting of extension officers held at the Agricultural Station, Sigatoka, a few months ago. During the course of these talks an appeal was made that grass should be regarded as a crop, and therefore worthy of care and management, and not as "something for nothing", a natural cover expected to provide at all seasons of the year free sustenance for livestock. The present condition of large areas of grazing land in the Colony points to the need for a changed outlook on the part of farmers, and more particularly by the small farmer who is also a grazier.

The extent of flat and gently sloping fertile land in the Colony is very limited and the pressure of the increasing population will result in most of this being brought under the plough for the planting of food and cash crops, except where special circumstances made it profitable to use such land for the production of milk for sale. This means that the majority of farmers and graziers must depend on hill lands to provide the bulk of feed for the maintenance of their livestock, whether for meat, milk or draught. The hill lands are for the most part low in fertility and the grass cover is maintained in somewhat precarious balance under the influence of fire and (in the dry zone) intermittent rainfall. The stock carrying capacity of such land is low and any failure to limit the livestock population is rapidly followed by the replacement of grass by useless weeds. Even on fertile lands in the wet zone, where the growth of grass is much stronger, there are all too many examples of uncontrolled grazing having resulted in a dense cover of shrubby weeds crowding out the pasture grasses.

Whatever improvements may ultimately be possible from the introduction of better types of grass and legumes, and the top dressing of pastures, no grassland can stand up to uncontrolled grazing. Not only must a limit be set to the total number of stock which land of any particular class should be expected to carry, but the management of the land must be such that the stock can be rotated around the grazing paddocks so as to give the grasses a sufficient period in which to recover and re-establish their lead over the competition of unpalatable weeds. On extensive hill lands such management implies either the fencing of the land into paddocks which may be grazed in rotation, or, if fencing is not possible, the controlled herding of the stock to achieve the same object. To create so-called "grazing commons"—by which is meant the setting aside of a block of land on to which neighbouring farmers turn their beasts in unlimited number to wander at will—is to invite the rapid spoliation of the land.

The demand for meat and other livestock products has increased enormously. This demand must be met partly at least from the better utilization of the hill lands of the Colony, but some relief will be possible if more arable lands can be brought under a system of alternate husbandry, i.e. a few years under the plough followed by sown grass. The latter period provides not only for the recovery of fertility of the soil through an improvement in soil structure but also for the depasturing of livestock on a grass "crop". A farmer who can organise his production on the basis of half his good arable land under crop, half under temporary pasture and his hill land fenced into paddocks of suitable size will have achieved a balanced system of farming both as to production and the maintenance of fertility.

It is to these ends, the achievement of a system of alternate husbandry under local conditions and the economic utilization of hill lands, that the work on our stations is essentially directed.

—C.H.

OBITUARY—THE LATE C. H. KNOWLES

It is with regret that we record the death on 4th October, 1951, of Charles Henry Knowles, who was from 1905 until 1921 Superintendent of Agriculture in Fiji. Mr. Knowles was responsible for much of the early work of the Department which had to be carried out, especially in the field, under conditions differing greatly from those of to-day. He left this Colony on transfer to the Gold Coast where he remained until his retirement in 1924 from the post of Director of Agriculture.

* * *

With the passing of C. H. Knowles Fiji loses one who, in its early days, did much for agriculture in this country. At Nasinu he not only established plots of all types of tropical economic plants and carried out tests of varietal resistance to certain diseases but he also gave attention to ornamental plants and planted such commercial timber trees as teak and mahogany.

Keenly interested in biological methods in the control of pests and weeds, it was under his supervision that the *Plæsius* beetle was successfully introduced to reduce the attacks of the banana borer, as well as several other beneficial species, including the Lantana fly and the first parasites of the scale, *Aspidiotus destructor*. It was also under his instructions that I opened up the correspondence with Trinidad which led to the discovery of the thrips *Liothrips urichi*, which many years later was so successfully brought to this country for the control of the weed *Clidemia hirta*.

Prior to his departure from Fiji he was already in touch with Malaya regarding the use of parasites of *Artona cataxantha* for the control of *Levuana iridescens* and it was one of the parasites of this moth which eventually brought the pest under such spectacular control.

Extremely versatile, a skilled musician and possessed of a wide knowledge of chemistry, entomology and mycology he was also interested in geology and meteorology, whilst he had a remarkable index-like mind, so that, when asked a question, he would often not only give the reference but the page at which to look.

It was with deep regret that I heard of the passing of one whom I had found helpful at all times and to whom I am personally greatly indebted for advice and guidance.

—H.W.S.

TOBACCO WEED IN VANUA LEVU

Tobacco weed is proclaimed as a primary noxious weed in Vanua Levu (Schedule B) because at the time the Regulations were amended it was recorded in only one locality —Wainunu.

It is now reported at the following places:—

Bua Province—Wainunu Estate ; Muanicula Estate ; Kauwaqa Estate.

These infestations are heavy on an area of more than 200 acres in the aggregate—and form the major source of spread in the Island. Light infestations occur at Nasavu Koro, and along the native tracks between these place and the Estates mentioned above.

At Nasarawaqa and Lekutu it is widespread and heavy over about half-an-acre on Indian occupied land. The weed has been practically eradicated by several sprayings along native tracks in Wainunu districts and at Daria, Nakawakawa, Saolo and Cogea.

A very small amount of spraying has been done at Kauwaqa Estate in association with the Field Officer of the Department and some attempt has been made to clear by cutting over 30 acres of infested land. Regrowth has occurred, however, and the weed has not been checked.

Cakaudrove.—At Devodara Estate in Savusavu a small patch has been eradicated. It is still considered possible to control this weed, which is susceptible to the 2.4-D weedkillers, and try more effective action to eradicate it from the island.

—B.E.V.P.

AGRICULTURE . . .

LAND UTILISATION

At a meeting of extension and station staff held at Sigatoka on 17th July, 1951, four papers concerned with land utilisation were read. They aroused great interest and it was decided that they warranted publication.

INTRODUCTION TO THE PROBLEM OF EFFICIENT LAND UTILISATION

BY W. J. A. PAYNE, ANIMAL HUSBANDRY OFFICER, SIGATOKA

The total land area of the Colony consists of some 4,500,000 acres of which approximately 1,700,000 acres are under some form of grass cover, while the remainder is cultivated lowlands, rain forest, or swamp. Parham (1947) estimates that there are 350,000 acres of cultivated land of which 164,000 are devoted to the two cash crops, coconuts and sugar-cane, 27,000 acres to grains, 22,000 acres to roots, 5,000 acres to pulses and the balance to miscellaneous crops or weed fallow. There are also some 500 acres of cultivated fodder crops, 50,000 acres of permanent grassland, and 200,000 acres of natural grasslands utilised for grazing.

The rapidly rising population and the distribution of land ownership makes it necessary to discover the most efficient methods of utilising the available land. The cultivated area is relatively small, being less than one tenth of all the land in the Colony, and it is unlikely that this area can be quickly expanded. Thus we must first consider utilising the existing cultivated area to the best advantage, and then attempt to make more economic use of the other nine tenths.

The efficiency of arable farming in Fiji is a debatable point, but it is only too apparent that in some of the sugar growing areas extensive erosion has begun, and I hope that the Assistant Soil Conservation Officer will discuss this aspect of the problem later in the morning. I have no objective information on yields of our arable crops but my impression is that they are low and I am informed that in some areas they are falling. It would be surprising if this was not the case, as very little artificial fertiliser is used, and the temporary "ley" which in other countries maintains or even builds up fertility, is unknown. Our "pastures" are either permanent grasslands, rough grazings or weed fallows, and I venture to say that few farmers in the Colony to-day look upon pasture grass as a crop.

TABLE I.

A COMPARISON OF THE AVERAGE ANNUAL YIELD AND FOOD VALUE OF A VARIETY OF CROPS GROWN IN THE ROTATION AT A.S.S.

Yields are average for the Colony, while the food values have been extracted from an F.A.O. bulletin (F.A.O., 1949).

Crop.	Yield. Cwt. acre.	Food Value. Calories acre. ('000,000).	Protein gm. acre. ('000).
Grains—			
Maize	20	3.6	95.3
Rice	15	2.7	71.5
Pulses—			
Peanut (in shell)	4	0.8	36.5
Pigeon pea, Mung, Urd, etc. ...	4	0.7	44.6
Roots—			
Tapioca	160	8.8	72.3
Yam	200	9.0	210.7
Dalo	200	8.6	150.5
Potato	80	2.8	68.2
Kumala	120	5.8	66.2
Pasture—			
(1) Guinea-centro mixture (A.S.S.)	390	13.1	450.0
(2) Converted into milk ...	3.3	1.1	57.3

(1) Estimate based on data from "Feeds of the World", Schneider, B. H. (1947).

(2) Based on carrying capacity and average yield at A.S.S., 1950.

Not only is grass a crop and must be managed as a crop, but it is probably the

most important crop that we have. It is certainly the most productive in terms of animal feeding stuffs as will be seen from Table I, and it has the additional advantage of helping to maintain soil fertility and preventing erosion. Even when pasture is converted by the animal to meat or milk its feeding value in terms of human nutrition compares well with that of other crops.

Pasture grass is then a PIVOTAL CROP. The question is, " How can we fit it into our farming economy ?" In parts of Western Europe we have for two or three centuries rotated crops with " leys " or temporary grass, and this system of farming is known as alternate husbandry. Mr. Laing will discuss alternate husbandry and the management of grass " leys " and you will have adequate time to discuss this system of farming with him. With regard to the other nine-tenths of our land: a great section of the rain forest area must remain under forest cover, and timber is the obvious crop, although areas may be devoted to other economic tree crops. Expenditure of large sums of capital will be needed for the drainage of both coastal and inland swamps, but when this capital is provided there should be no technical difficulties in bringing this land into cultivation.

The remaining area is mainly rough grazings and it is to this area that we must look for the most rapid increase in productive capacity in the future. Some rough grazings would be most efficiently used growing timber, but most should be growing beef, mutton, and goat meat, and supplying breeding stock for the farmers in the cultivated lowlands. Mr. Laing will also discuss the management of grazings, and though I do not wish to trespass on his field I must emphasize that the uncontrolled grazing of vast areas can only lead to disaster, and that rough grazings must be managed just as, even perhaps more intelligently, than temporary " leys " on the cultivated area.

REFERENCES.

F.A.O. (1949).—*Nutritional studies No.* 3; *Food Composition* Tables, Washington.
Parham, B. E. V. (1947.—Fiji Agric. J., 18, 26.
Schneider, B. H. 1947.—*Feeds of the World,* West Virginia.

ALTERNATE HUSBANDRY

BY W. I. LAING, AGRICULTURAL ASSISTANT, SIGATOKA

An alternate husbandry system of farming is one in which animal and crop husbandry are both practised on the same land at successive times. It is only possible on land where the plough does not upset the stability of the soil and is usually associated with short duration pastures. In evaluating this system under our conditions we can only compare it with the more general systems of virtual monoculture, shifting cultivation, weed fallow, and permanent grazing.

It is a system that can be practised on our river valley and coastal flats and has many real advantages over the existing systems. It means, however, that the farmer must become more skilled as he must master not only the art of growing cane or rice, but also the art of managing stock and pastures. In fact we are advocating a relatively complex and to the peasant a completely new method of farming, which, if adopted, would mean ultimately an agricultural revolution.

Let us examine this alternative husbandry system and see what its main advantages are.

Firstly, and probably most important of all from the economic view point, it is a diversified system. The farmer is shielded against financial losses due to adverse weather, specific market collapses, pests and disease. Moreover the farmer's income is evenly spread throughout the year and he thus becomes freer of long term credits. This is in marked contrast to the two or three payments per annum paid to the cane grower.

Secondly, crops can be varied at short notice to suit changes in demand, unfavour-

able weather, or other cricumstances, as the farmer has a large choice of short term and long term crops. Such efficient utilisation of the land at all times is usually associated with high output per acre compared with other systems, and this in turn supports greater capitalisation for machinery, drainage, fertilisers etc., with ever-increasing utilisation of the land and greater efficiency of the labour employed. Its flexibility also makes it a valuable adjunct to stock raising on the hills, as silage and other forages can readily be incorporated into the normal rotation.

Thirdly, an alternate husbandry system assists in the maintenance of fertility, in the control of erosion, in the suppression of weeds, and in the control of animal and plant parasites and disease. This section will be enlarged on later in the paper.

Finally, it has a profound sociological significance. Once the farmer begins to realise the interrelationship of climate, soils and fertility, stocking rates, nutrition and disease, he will be well along the road to prosperity. As long as he is tied to the traditions of his forbears, with dwindling fertility, accelerated erosion and diminishing returns on the one hand, and a mushrooming population on the other, he can never dream of an improved standard of living.

We will now turn to the more specific benefits of the particular rotation which is in operation at A.S.S. It should be understood that there are many such rotations and we claim no originality for the essential plan we follow ; it was operating in Norfolk at the close of the eighteenth century. Our present plan is briefly this: after three years underr pasture a field is ploughed to roots. When the roots are lifted a grain crop is drilled, followed in turn by a pulse crop and then by another grain crop. The pasture is re-established without additional ploughing and cultivation merely by undersowing the last grain crop with the requisite seed mixture. The root crops can be potato, tapioca, yam, dalo, and kumala ; the pulse crops can be peanuts and a variety of peas and beans used as dhal or green vegetables ; and the cereal crops can be rice, maize, and sorghum. The rotation should take six years to complete, three years under grass, and three under crops.

The pasture phase is the most essential of all. Dr. Payne has just shown how well the grass crop compares with other crops both directly for animal feeds and indirectly for the milk produced from the feed. Not only is this true, but high quality pasture incorporating large amounts of legume and carrying large numbers of stock is the cheapest and simplest of restoring the soil fertility removed by continuous cropping. It increases the humus content and hence the water holding capacity and availability of plant nutrients. It increases the nitrogen content of the soil so necessary for satisfactory growth of both roots and grains. It improves the structure of the soil, aiding aeration, surface drainage and subsequent cultivation. It acts as a smother crop to all but the most resistant weeds and even these are killed by the heavy trampling, harrowing, and mowing that the pastures receive. Finally the grass cover acts as sponge absorbing the torrential tropical rains and impeding the run-off and consequent losses of topsoil. Grassland husbandry has thus a vital part to play in maintaining nutritional and economic standards and in preserving fertile topsoil for future generations.

The roots and all row-crop cereals and pulses allow frequent intercultivation. This aids in the formation of tilth and also kills weeds whose seeds have been lying dormant during the grass " break ". One complete rotation should therefore markedly reduce the weediness of any field, and allow the more valuable plants undisputed use of their food elements. It is only too apparent today that the weeds are getting the " lion's share " of the residual fertility of our arable land.

The main role of the pulses in the rotation is to restore nitrogen to the soil. It has been found by experience that nitrogen is generally the factor limiting growth on otherwise fertile soils and the cheapest way to build

up this nitrogen prior to sowing the second grain crop is by sowing a pulse. A plant such as pigeon pea with its extensive root system helps greatly in this respect, besides acting as a subsoiler. This pulse has a dual function as it provides valuable forage for the stock as well as dhal for human consumption.

Before concluding this brief discussion we would like to refer to the culture of sugar cane and coconuts. It is possible that increased yields could be obtained in Fiji if cane was incorporated into such a rotational system as we have outlined. Cane, like fodder grasses, is less depletive of lime and phosphate than grain crops, but it does not provide the nitrogen or organic matter of the pasture. Rotations are being tried at P.A.S. to find those most suitable for our conditions. If existing overall yields could be maintained on a smaller acreage, as we believe is possible, more land would be available for growing other food crops.

Copra production is not likely to be superseded and indeed any system which requires reduced acreages under coconuts must be regarded with extreme caution. On the contrary we believe that efficient land utilisation implies the best possible use being made of all land including fencelines, irregular areas, and small gullies unsuited to ploughing. In an alternate husbandry system we need shade for the stock and coconut palms provide excellent shade. If all the fencelines and other unploughable areas bordering our crop lands were fully planted to suitable permanent crops of which coconuts could be one, the production of our farms could be greatly increased. We could discuss the pros and cons of alternate husbandry for a much longer time than we have done, but we would prefer you to learn these through experience. As we have said before and as we will be repeating in the field, no other system can supply the three main essentials so adequately. Let us conclude by reiterating this "agricultural trinity": firstly the farmer's income, secondly the nation's food supply, and thirdly the fertile topsoil essential for growing food for future generations.

PASTURE MANAGEMENT

By W. I. LAING, AGRICULTURAL ASSISTANT, SIGATOKA

You have already heard that we consider pasture to be the most important crop in our rotation. Moreover it is a long term crop which requires careful and highly specialised management if it is going to produce satsifactorily.

Let us consider the various types of pasture that we will have to learn how to manage. Firstly there is the short term "ley." We have reached no finality as to the best components of these "leys" but it would appear that the common species "Guinea", "Para", "Centro", and "Desmodium" are all satisfactory from both the field and nutritional viewpoints. We do not wish to suggest that these are the only suitable plants or even that they are the best but we do have more information on these species than on most others and it is to their management that we will confine our attention. We would welcome, however, questions and discussion on other plants such as the "Blue grasses", "Mission" and "Creeping Indigo". Secondly there are the permanent pastures which we recommend purely for unploughable hill grazings. The management is quite different from that of "leys", and, on account of the extremely variable soil fertility and moisture conditions on the hills, the range of desirable species is somewhat wider. We feel at present that "Guinea", "Molasses", "Mission", "Para", and several "Blue grasses" all have their value as well as "Desmodium", "Alysicarpus", and "Centro". Finally there are special pastures and fodders. These consist of high yielding giant species which are not suited to normal grazing conditions and are generally less permanent than even the short

CENTROSEMA—GUINEA PASTURE.

DETAIL OF CENTROSEMA—GUINEA PASTURE.

term leys. At present we recommend intercultivation as a special management practice for most of these. Some may be grazed or browsed judiciously whilst others are only suited for silage, soilage, and possibly hay production. Useful grasses are "Elephant", "Guatemala", and "Kavirondo sorghum" and useful legumes "Vaivai", "Desmanthus", and "Pigeon pea".

TEMPORARY LEYS.

From the point of view of cost, sowing is by far the most satisfactory way of establishing leys on large areas. With "Guinea", "Centro" and "Desmodium" this is certainly true but even with "Para" the relative costs of spreading seed or large quantities of green stems are in favour of the seed. Unfortunately "Para" seed is not readily available at present and the ploughing in of lines of mature stems is probably the most satisfactory alternative method.

Present knowledge indicates that the best time to establish pastures is in the middle of the dry season, that is August or September. In very dry years it may be advisable to wait for rain before sowing. Firm seedbeds and mechanical drilling both help, but as the majority of farmers do not possess drills, broadcasting by hand and then harrowing over the seed is the next best alternative. We advise not less than ten pounds of "Guinea", "Para", or "Centro" seed per acre but three pounds of "Desmodium" is adequate. With the exception of "Para" seed for which we have no information, all these seeds remain viable for many months after harvesting.

The first point to decide after establishment is when to graze. Young "Guinea" seedlings are shallow rooted and easily pulled up by stock. It is probably better at first to mow rather than to graze "Guinea". This can be done two to three months after sowing to encourage tillering and to check weed growth. The cut material can be ensiled if required. "Para" may be lightly grazed earlier than "Guinea" but subsequent mowing is desirable to check the weeds. "Centro" is the best legume to mix with "Guinea," but either "Desmodium" or "Centro" or both can be mixed with "Para".

The first moderately heavy grazing should be not earlier than six months after establishment, that is in March or April, but no more than two such grazings should be taken before May. Even with established pastures less than one tenth of the annual production is obtained from May to August and during this period we must be most careful to avoid overgrazing, especially during the first season. It is at this stage that we must decide how we are going to control the grazing animals. At the outset we wish to emphasise that every field on an alternate husbandry farm must have fences that are stout and completely stock proof. Young maize and peanuts are too tempting to the stock and too valuable to the farm to take any risks. Good ring fences round all fields makes further subdivision relatively simple. We advocate the system variously described as "close folding", "rationed" or "fore-and-aft" grazing. This method makes use of portable electric fences to divide the fields into a "ration" large enough for the herd for one day only. This "ration" will vary in size with the amount of growth of the pastures and the number of animals in the herd. On very small holdings the animals can be tethered in order to ration them across the available grazing. Quick defoliation followed by spelling enables all the plants to recover quickly, and over a period the maximum production of high quality feed is obtained. Workers at Jeallott's Hill research station in England compared close folding with "rotational" grazing. Over a period from April 19th to August 14th (the English summer) "close folded" pastures produced 487 gallons of milk per acre compared with 387 gallons from those "rotationally" grazed. The comparison with "set stocking" would have been even more favourable to "close folding".

We regard harrowing after each grazing, and mowing occasionally, as essential practices. Harrowing spreads the fresh dung and gives a more even manurial effect over

the whole field. Mowing, especially in the first season, encourages tillering, improves leafiness in the grasses and hence pasture quality, allows light in to the pasture and so encourages the low growing legumes, and checks weed growth. If " Para " pastures have been neglected heavy discing will rejuvenate the sward and greatly improve the feed quality.

It is most likely that all pastures will benefit from the application of lime and phosphate. A pasture producing 750 gallons of milk per acre annually has nearly one hundredweight of lime and three hundredweight of phosphate removed by the grazing cows in their milk. This deficit has to be made up if the soil fertility is to be preserved and the pastures are to produce at a maximum. We do not know the most economic levels at which to apply limestone, coral sand, or phosphate but we think at least the amounts normally applied in New Zealand are justified, that is one to two hundredweight of phosphate and one ton of lime per acre annually. On account of the acidity of many of our soils and hence the rapid fixation of soluble phosphates we feel basic slag is one of the most suitable phosphatic fertilisers to use. It is also cheaper than " super " and in addition it contains many trace elements such as copper or cobalt which may not be readily available to plants on some of our soil types. The application of nitrogenous fertilisers to pastures is a very debatable question. Undoubtedly there are occasions when their use can be justified, such as with new pastures or pastures where the legume content is so low that the grasses are insufficiently fed with nitrogen, but in general we prefer to add the nitrogen indirectly through the legume. We feel that nitro-chalk is probably the best nitrogenous fertiliser to use as it is basic and slower acting than the acidic sulphate of ammonia.

So far we have omitted mention of " undersowing ", that is the use of a " nurse crop " at establishment. If we sow our grass seed under a tall cereal such as maize or sorghum we save extra cultivation as well as using the " nurse crop " to protect the seedlings against buffeting winds, torrential rains or undue weed competition. Within the rotation this would seem a very desirable practice.

HILL PASTURES.

Hill pastures are different from those designed for the flats in that they have to be established and maintained largely without the aid of implements. Pioneer work in New Zealand on spreading seed and fertilisers from low flying aircraft and blowers is showing great promise but we are not quite ready for these developments in Fiji. We are aiming to establish on some hills, pastures that are almost as good as those on the flats but with the added qualities of longevity and resistance to erosion.

Firstly, and easily the most important of all, is the control of the grazing animal. Roaming stock are one of our major curses to-day. Adequate fencing of course implies heavy expenditure which few individuals or co-operatives can undertake at present We are trying to find cheaper fences all the time and have recently imported for trial some chains which are being used to replace fence posts and batons on hill country fences in New Zealand. Of course what we aim to do with fences can be also achieved by intelligent herding.

If proper control of all stock is feasible then improvement is possible ; without it our efforts are wasted. It is useless if wandering stock are going to graze out the the best species as soon as the herdsman has moved to a fresh area. Our aim is to change the hill vegetation from one with few valuable species to one basically similar to the " ley ". This normally means the suppression of woody or otherwise unpalatable species and the encouragement of existing valuable species with or without the establishment of new ones. We will not consider clearing true rain forest as this is probably best left as forest. At A.S.S. we have no hard and fast rules. We use goats and cattle to browse and trample down woody plants such as " Guava " and we recommend this along with limited controlled burning to reduce the tall grasses. Lest we

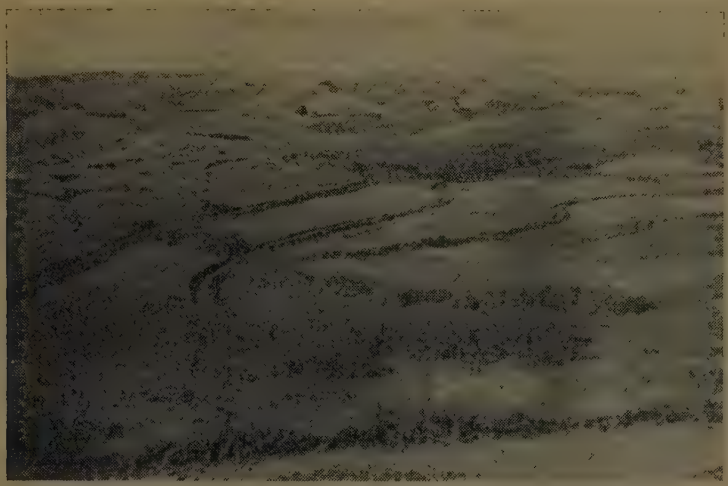
be misunderstood we do not in general advocate burning at all, but this is easily the cheapest and most satisfactory way of reducing isolated patches of reeds to a fertile seedbed. If the slopes are not too extensive and provided plenty of grass and legume seed is broadcast on the ashes the chances of serious erosion are not very great. We advocate broadcasting the desirable seeds in March, or from August to November, whether the area has been cleared by firing or not. Some hand clearing or spraying of weedicides may be justified if weed areas are not too extensive.

Subsequent management is similar to the management of the leys only the rotation, of necessity, is not so rapid. Where possible we mow with the Allen Scythe but of course harrowing is impracticable. We intend top-dressing with slag. Our information so far has been rather scrappy, but we would like to emphasise once again the potential value of the hill grazings of the Colony.

SPECIAL PURPOSE PASTURES AND FODDERS.

In general growth is very rapid from September to April but very slow from May to August. This of course raises problems in pasture management as well as in the provision of stock feed. Following the practice of most temperate lands where dry summers and long cold winters present similar problems we have two lines of attack. Firstly, we can conserve the surplus production of the October - November " peak " period by making silage, and the March - April growth by less frequent grazing during those months —certain fields could be " shut up " for one round in the rotational grazing—or we can plant special crops. Under our special conditions a combination of both practices seems desirable. " Elephant " grass and " Kavirondo sorghum " both produce well during this critical period as do the high quality fodder legumes, " Desmanthus " and " Pigeon Pea ". " Guatemala " grass is probably well suited to the wet zone. All the legumes and the sorghum can be grown readily from seed. High yields are obtained by sowing or planting in drills and intercultivating ; " Kavirondo sorghum " can be sown in close drills or even broadcast, using heavier seeding rates if large quantities of high quality forage are required either for grazing or silage. The disadvantages of this method is that recovery is not so good as with wider drills and only three grazings or cuts can profitably be taken. It is most probable that the inclusion of a legume with the giant grasses would improve both the yields and quality. So far our limited stocks of legume seeds have not permitted us to test this supposition.

In conclusion we would like to re-capitulate some of the earlier statements made both in this and other papers. Pasture is a crop and we consider that it is at least potentially the most important crop in the Colony. It is certainly the most neglected crop. Field Assistants and Veterinary Assistants alike should do their best to appreciate the importance of pasture—it is not " just grass " or " a paddock where you put the cows ". It is the very backbone of our livestock industry, and an insurance scheme against diminishing agricultural returns. Our health and prosperity are both intimately linked with the productivity of our pastures. Let us not henceforth neglect this vital section of the Colony's agriculture.



A RECENT PICTURE OF NARROW BASED TERRACES CONSTRUCTED AT SABETO, NADI ON SLOPING LAND.

NARROW BASED TERRACES AT SABETO, NADI CONSTRUCTED WITH A TRACTOR AND GRADER. NOTE WATER-WAY FOR SAFE DISPOSAL OF WATER INTO THE RICE FIELDS.

SOIL CONSERVATION

BY S. RAMJAN, ASSISTANT SOIL CONSERVATION OFFICER

Soil erosion can be best described as the theft of soil by the elements, and is the removal of soil particles either singly or in mass. The soil is mankind's greatest resource. The top layer which is so easily removed by both wind and water is essential to food production and the only defence against erosion in some parts of the world is a thick cover of permanent vegetation. Man, however, has to clear this permanent cover in order to grow food crops, and so erosion occurs. Not infrequently in Fiji we have intense storms of short duration when several inches of rain fall in one hour on arable soils on the hill sides, some of the top soil is then washed away and the remainder is packed tightly making an impervious layer. The rain then runs over the soil, carrying particles down the slopes into the creeks, ruining the hill soils and silting up the rivers. A soil conservation plan must make provision for these storms, and some of the various measures that can be taken include channel ways, pasture furrows, contour banks, gully control structures, contour cultivations, and the use of pasture in the rotations.

CHANNEL WAYS.

Where natural pasture depressions are not available it is necessary to construct water-ways and establish grass cover well ahead of banking operations. These water-ways are constructed as near as possible to the natural drainage line usually at right-angles to the contour lines, and should be of sufficient width, and should be level, so that the water is spread evenly and widely. The construction of water-ways is a comparatively simple operation, merely involving the use of a grader. Soil is moved from either the inside or the outside to the water-way to form the containing banks and the area between the banks is then levelled.

Following construction and sowing of water-ways, it is usual to spread a layer of stubble over the entire surface. This mulch protects the water-way from scouring during heavy storms in the early stages.

PASTURE FURROWS.

Pasture furrows are a series of furrows on the true contour without any fall. They are opened up with a plough or grader and so spaced that they will pond a maximum amount of water without over-topping.

It is interesting to note that pasture furrows constructed with a road plough or an eight foot grader blade usually have a cross section of one square foot representing a capacity of 20,000 gallons of water per acre. The value of this additional water for pasture growth is clear.

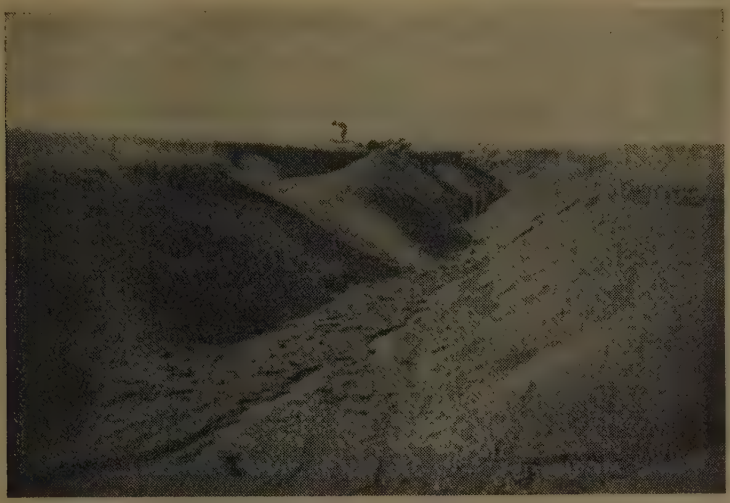
In the Sabeto area pasture furrows have been constructed with the idea of promoting better grass growth. Furrows were opened up with a G.O. plough and then basin listed by hand. These functioned well. There was a stronger growth of grass than in areas where there was no treatment. It was noticed, however, that soils in the Sabeto area "melt" very quickly, thus necessitating larger pondage basins to be installed

CONTOUR BANK.

The contour bank is the chief mechanical measure utilised for erosion control on arable land. It may be defined as a bank with a channel above, built across the slope at suitable intervals, and with a gradiant towards the outlet.

The object of contour banking is to check the direct run-off before it gains sufficient volume and velocity to cause excessive erosion of the soil. The gradient must be sufficient to dispose of the anticipated run-off, but not sufficient to produce erosion and scouring in the channel or the bank of the drain.

Falls recommended in Fiji are 1 in 180, and for storm drains 1 in 90. The first step in planning a system of contour banks is a careful examination of the physical features of the area. Natural drainage and water-way sites are an important consideration, as also are the slope, ridges, paddocks, roads,



A GULLY AT SABETO, NADI. THIS ONE IS APPROXIMATELY TWO CHAINS LONG BY ONE HALF CHAIN WIDE.

THE GULLY DEPICTED IN ILLUSTRATION NUMBER THREE. STABILISED WITH GROITED STONE DAMS.

and buildings.

For marking out contour base lines either an Abney level, T-level or Sighting level can be used.

When surveying lines for contour banks, it is necessary first to determine the slope of the land on the site of the first banks. Spacing is determined by reference to Table 1. Wider experience may necessitate modifications of this spacing table, but the spacing formula is safe and practical.

TABLE I.

DISTANCES BETWEEN CONTOUR BANKS ON VARIOUS SLOPE.

Slope (per cent).	Vertical Interval (feet).	Horizontal Distance (feet).
2	3.00	150
3	4.05	135
4	4.80	120
5	5.25	105
6	5.70	95
7	5.95	85
8	6.40	80
9	6.75	75
10	7.00	70

There are two types of banks, narrow based and broad based. Narrow based banks are built on steep slopes, and the spoil for the bank is largely obtained from the top or channel side of the bank. Broad based banks are usually constructed on gentle slopes, and there the spoil is obtained almost equally from both sides. Cultivation can be done on this bank. It is important to have both the bank and the channel with a smooth continuous gradient throughout the contour length. A bank is no better than its weakest point and if any low spots occur they should be immediately built to the normal bank height by the use of scoops or other implements. Banks of inadequate size can frequently be damaged through overtopping.

GULLY CONTROL STRUCTURES.

Many farmers do not become aware that soil erosion is robbing them of the precious soil until gullies appear and make their paddocks awkward to work. First, it is important to deal with the conditions that cause the appearance of the gullies (i.e. overstocking, up-and-down-hill cultivation, etc.). Remedial treatment consists of building dams either of stones or debris. Stone groined dams are beyond the limits of most farmers and therefore we must concentrate on the building of live brush dams. These structures consist of upright poles set deeply into the valley or gully in two rows, some three feet apart. Between these poles brushwood is laid crossways, until the desired height is reached. Then finally soil is placed on to prevent the brush wood from shifting. When the dam is filled with silt the height must been raised by placing another row or two of poles upstream, and building the same type of dam. The object of the brush-wood dams is to reduce the flow of water and to raise the height of the gully floor step by step thus reducing erosion.

CONTOUR CULTIVATION.

You all have heard the term "contouring". This refers to any tillage practice or mechanical treatment of cultivated land carried out across the slope on the contour.

It has been the practice, as you must have seen in the sugar cane areas, for cultivation lines to parallel field boundaries, having no regard for the direction of the slope. Contour cultivation does away with straight lines, by following the natural lines of the land. In other words you are almost always working on level ground. The object and the usefulness of working on the contour is that the contour furrows catch and hold some of the water and store it in the soil. This ensures some conservation of rainfall and reduces the run-off as each furrow acts as a small dam.

Contour cultivation, unsupported by contour banks or narrow base terraces, is itself an effective method of checking run-off and controlling erosion on gentle slopes, but where there is a high rainfall such as we have in Fiji, there is every likelihood that by contour cultivation alone, surplus run-off cannot be controlled and it thus becomes necessary to construct bunds or terraces.

ANIMAL HUSBANDRY . . .

AN INTERIM REPORT ON THE DEPARTMENT'S PIG BREEDING PROJECT

BY W. J. A. PAYNE, M.A. (CANTAB.), DIP. AGRIC. SC., (CANTAB.), PH.D., (GLASGOW),
ANIMAL HUSBANDRY OFFICER, SIGATOKA

A pig breeding project was commenced in December, 1946, when the Department imported one Tamworth boar, one large white boar, and two large white sows. The object of this project was to create two highly productive herds of pigs with a view to comparing fertility, fecundity, growth, and carcass quality under local conditions.

The scope of this project has now been widened. The piggeries at Sigatoka are being modernised and extended, and a new range of piggeries has been built at Koronivia. When the extensions are complete there should be accommodation for some twenty breeding sows and their followers. A boar and gilts of the Berkshire breed are being imported from New Zealand this year, so that the Department will have breeding stock of three breeds. When these breeds are well established they will act as nuclear herds for the production and distribution of highly productive pig stock in the Colony.

Recent experiments in California by Heitman and Hughes (1949) have shown that the rate of gain is greater, and the amount of food required to produce 100 pounds of liveweight gain is least, at an average temperature of 75° F. for pigs weighing 70-144 pounds, and at an average temperature of 60° F. for pigs weighing 166-260 pounds. Thus Fiji with an annual mean temperature around 75° F. has an ideal climate for the production of porkers. We will now aim at producing pigs weighing 120-140 pounds liveweight as this should be the most economic form of pork production under our conditions.

Records of prolificacy and liveweight at birth and weaning are available for the four years 1947-50 (Table 1), but there is insufficient data to give details of mature growth.

It will be noted from Table I that the large white sows are consistently more prolific and probably have a better milk supply as their offspring are heavier at weaning.

TABLE I.

PROLIFICACY AND LIVEWEIGHT AT BIRTH AND WEANING OF THE PIGS AT A.S.S, 1947 - 50.

Year	Breed	No. Litters	Average number born alive	Average weight birth lb lb	Average number weaned	Average weight at weaning lb lb	Total weight of litters at weaning lb
1947	Large White	2	11·0	8·0	..	..	..
	Tamworth	4	7·5	2·9	....	....	....
1948	Large White	3	8·7	3·4	6·3	34·6	218·1
	Tamworth	2	6·5	3·0	4·5	25·4	114·3
1949	Large White	2	8·5	2·8	7·5	31·0	....
	Tamworth	2	7·5	3·5	6·5	26·9	....
1950	Large White	4	11·0	2·9	8·1	26·8	217·2
	Tamworth	7	7·4	2·5	6·9	19·6	134·0
Mean (Fiji)	Large White	....	9·9	....	7·4	....	....
	Tamworth	....	7·1	....	6·4	....	....
Mean (Britain)	Large White	....	10·2	2·5	7·9	28·2	....
	Tamworth	....	7·2	2·5	6·1	28·2	....
Davidson	(1948)	....	....	..	....	....	....

The Tamworths are, however, hardier and the number of piglets weaned as a percentage of the number born is higher (90.1 per cent Tamworths, as against 75.7 per cent large whites). There has been a steady improvement in the average number weaned of both breeds from 1948 to 1950, but a decline in the weaning weights. This may be attributed to changes in management. The nutritional plane of the sows has definitely declined since 1948 as no skim milk is now fed, and it is interesting to note that this decline in nutritional plane has affected the Large Whites more than the Tamworths. The increase in the number weaned has fully compensated for the decrease in the weaning weight so that in 1950 the total weight of the litter at weaning was slightly higher.

A comparison of the Fiji results with British results (Table I) shows that litter numbers and weight at weaning approximate to temperate standards.

Although this work demonstrates that the Large White and Tamworth breeds have a high prolificacy and produce quite well grown piglets at weaning, it must be remembered management conditions on the Government Stations are particularly favourable and that with the exception of a few producers the management of the majority of pigs in the Colony is of a very low standard. Even on the Government Stations nutritional problems, especially the provision of adequate animal protein in the diet, must be solved before the performance of post-weaners of the three breeds can be really objectively compared. On most farms there are also the problems of building cheap, suitably constructed piggeries, and ensuring a continuous and adequate food supply, before any real advantage can be taken of the breeding stock being produced on the stations for distribution.

At this stage we recommend that farmers with goods buildings, assured food supply, and a reasonably good standard of management should use the Large White breed, whereas other farmers should use the Tamworth which is apparently hardier and able to produce well on a lower plane of nutrition.

NOTE.—Large White and Tamworth breedings stock are already available and orders should be addressed either to the Director of Agriculture, Suva, the Animal Husbandry Officer, Sigatoka, or to any local extension officer of the Department of Agriculture.

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RECORDS FROM THE DAIRY HERD AT SIGATOKA FOR THE DECADE 1941 - 50

BY W. J. A. PAYNE, ANIMAL HUSBANDRY OFFICER, SIGATOKA

A small but steadily expanding dairy herd has been maintained at Sigatoka Agricultural Station for some ten years. At first it only consisted of a few animals of mixed and unknown ancestry. A Friesian type bull was used to grade the herd up, and at intervals Friesian type heifers were bought in from other island herds. The result by 1950 was a very heterogeneous grade Friesian herd.

The herd is very small, and during the decade there has been no uniform breeding, feeding, and management policy, nevertheless, in view of the paucity of continuous records in any island herd it has been considered worth while publishing what records are available.

In 1950 the herd was expanded and a definite breeding policy was formulated. All the existing grade Friesian stock will in due course be transferred to the Koronivia Agricultural Station, and a Shorthorn herd built up at this station. No details of the Shorthorn stock will be given in this paper as the foundation stock were only established at the station in 1950.

BIRTHS AND MORTALITY.

One hundred and sixty-two births were recorded during the decade of which seventy--one were heifer and ninety-one bull calves. The sex ratio was forty-four heifers to fifty-six bulls, and this is considered a normal ratio as it is usual to have a higher proportion of bull calves. Details of the number of births, stillbirths, and mortalities up to six months of age are given in Table 1. Details of post-calf mortality are given in Table 2. This table includes mortalities from six months to thirty months.

TABLE 1.
BIRTHS AND CALF MORTALITY 1941–50.

Year	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Totals
No. Born—											
Heifers ..	3	6	2	6	8	5	5	7	10	19	71
Bulls ..	6	3	7	5	8	7	9	17	16	13	91
Totals ..	9	9	9	11	16	12	14	24	26	32	162
Stillbirths—											
Heifers ..	..	..	..	..	..	..	1	..	..	1	2
Bulls ..	1	..	..	..	..	..	..	..	1	..	2
Totals ..	1	..	..	..	..	..	1	..	1	1	4
Mortality 0–6 months—											
Heifers ..	..	1	1	2	1	1	..	..	2	3	11
Bulls ..	..	..	2	2	3	1	..	2	3	4	17
Totals ..	..	1	3	4	4	2	..	2	5	7	28
Per cent Mortality ..	11·1	11·1	33·3	36·4	25·1	16·3	7·1	8·3	23·1	25·0	19·7

The average calf mortality for the decade was 19.7 per cent. Comparisons are difficult, but in Ayrshire, Scotland, Jordan (1933) reported a calf mortality of 20.0 per cent while Hector and Rowat (1948) reported 8.6 per cent. Payne (1949) in a survey of seven Scottish herds for the period 1932-47 reported an average mortality of 11.1 per cent. We may consider that the mortality was high, but not as high as is considered normal in the islands. The heaviest mortality was during the period of two to six months of age and although accurate records of the cause of mortality are only available for the period 1949-50 it can be assumed that the majority of the deaths were caused directly or indirectly by internal parasites. Veterinary officers of the Department have identified the following parasites from post-mortem examinations during the period 1949-51. Hookworm (*Bunostonum phlebotomum*), whipworm (*Trichuris ovis*), lungworms (*Dictyocaulus spp.*), *Setaria labiata-papillosa*, as well as eggs of other species of the Ascaroidea, Trichinelloidea, and Strongyloidea orders. Rumen flukes and coccidia have also been identified.

TABLE 2.

MORTALITY FROM SIX MONTHS TO THIRTY MONTHS.

	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Totals
Heifers ..	..	1	..	1	..	..	..	..	..	1	3
Bulls ..	1	1	1	1	..	..	1	2	1	..	8
Totals ..	1	2	1	2	..	..	1	2	1	1	11
Per cent total Mortality (Birth to 30 months)	22·2	33·3	44·4	54·5	25·0	16·7	14·3	12·5	26·9	28·1	26·6

GROWTH.

No animals were weighed until 1949-50, and then only the calves were weighed up to six months of age. Details of liveweight at birth, one month, and six months are given in Table 3.

It will be noted that the birth weights are low for Friesian stock, as are the weights at six months of age. Peterson (1950) states that average birth weights in the U.S.A. for Friesians are 90 pounds for heifers and 94 pounds for bulls while at six months average heifers weigh 355 pounds and average bulls 399 pounds. There is no doubt that there is dwarfing and slow growth with Friesian stock at Sigatoka. It is likely that the growth rate varies with the season of birth but the small sample does not allow analysis of the data along these lines. This slow rate of growth is characteristic of European type animals in the tropics and it has now been shown that there is a physiological limit to the growth of European type animals, Payne (1951) no matter how good the feeding, breeding and management.

TABLE 3.

CALF GROWTH 1949–50.

	1949		1950	
	No. animals	Liveweight	No. animals	Liveweight
		lb		lb
At birth—				
Heifers	10	69·8	17	58·5
Bulls	13	70·3	13	66·6
Total	23	70·1	30	62·0
At one month—				
Heifers	8	100·3	16	92·3
Bulls	12	106·3	11	108·7
Total	20	103·9	27	99·0
At six months ..				
Heifers	8	215·9	15	160·8
Bulls	11	233·0	7	186·4
Total	19	225·8	22	169·0

No records are available of butterfat percentage in the milk produced, but records of milk production are available for the whole decade and are given in Table 4.

The average length of dry period fluctuated widely and the high figure for 1950 can be attributed to the fact that the management changed in 1949 and several animals that had not calved for a very long period were served and brought back into the milking herd. The average length of lactation did not vary so much but it is still below the aim of a 305 day lactation. The steady rise in average milk yield was very satisfactory and the average for the herd in 1950 was well above the average production that is usually quoted for tropical countries, Wright (1951), Hutchinson (1941).

TABLE 4.

AVERAGE LENGTH OF DRY PERIOD, LACTATION, AND CORRECTED (305 DAY) MILK PRODUCTION FOR THE DECADE 1941–50.

Year	No. lactations	Average length of dry period	Average length of lactation	Milk yield (corrected 305 days)
1941 ..	3	?	207	1,327lb
1942 ..	9	178	243	1,960
1943 ..	7	141	238	2,748
1944 ..	11	123	269	2,983
1945 ..	11	63	293	3,252
1946 ..	14	57	280	3,688
1947 ..	8	89	254	4,036
1948 ..	22	86	265	4,685
1949 ..	18	73	249	4,998
1950 ..	25	167	260	5,183

CONCLUSIONS.

Records for a decade from the grade Friesian herd at the Sigatoka Agricultural Station show that calf mortality is fairly high by temperate zone standards and that deaths are mainly due to the direct or indirect effects of parasite infection. Birth weight is low by temperate zone standards, and growth in the first six months of life is very slow. Production has been rising throughout the decade and is now moderately high by tropical standards.

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THE JOURNAL

Readers are asked to note that with this issue the attempt to make up lost time in publication is being reluctantly abandoned and a new volume commenced. Volume 21 is therefore completed by the third number, September, 1950. Annual subscriptions will of course continue to cover four numbers of the Journal, irrespective of dates of publication.—Ed.

ECONOMIC BOTANY . . .

PLANT INTRODUCTIONS—1950

BY B. E. V. PARHAM, O.B.E., M.A. (HONS.), ACTING DEPUTY DIRECTOR OF AGRICULTURE

During 1950, considerable attention was given to the reorganisation of the plant introduction activities of the Department; and with the assistance of the grant-in-aid under the Economic Development Plan of the South Pacific Commission, it has been possible to develop a Plant Introduction and Quarantine Station at Naduruloulou where certain facilities and extensive plantings of valuable species had already been established during the period 1933 - 1945.

The present note records a few of the 233 separate introductions made during the year, a complete list of which will be published elsewhere. Many of the plants mentioned have been distributed to other Departmental stations for further trial and observation.

FODDER AND PASTURE PLANTS.

(*a*) *Grasses.*—Twelve species, including seven strains of Guinea grass (*Panicum maximum*) from Australia, and three other species from Hawaii.

(*b*) *Legumes.*—Twenty species from Hawaii, Australia, New Zealand and El Salvador. Of particular interest are:—

Creeping indigo (*Indigofera endecaphylla*).

Rhodesian kudzu (*Glycine javanica*).

Grazing lucerne (*Medicago glutinosa*) and several species of tropical trefoils (*Desmodium* spp.)

Other Fodder Plants included four kinds of kale and choumoellier (*Brassica oleracea* var. *acephala*) from New Zealand.

ROOT CROPS.

(*a*) *Yams.*—Thirty-three varieties of the following yam species were established:—

True yam (*Dioscorea alata*).

Lesser yam (*D. esculenta*).

Air potato (*D. bulbifera*).

Wild yam (*D. nummularia*).

Amongst these were eight selected varieties from New Caledonia.

(*b*) Sweet potatoes (*Ipomœa batatas*).—Two varieties including one from Hong Kong and one from Tokelau group—suitable for cultivation in coral sand islands;

(*c*) Aroids (*Colocasia, Amorphophallus, Alocasia*)—3.

(*d*) Arrowroot (*Tacca pinnatifida*)—2.

(*e*) Spices—Ginger (*Zingiber officinalis*)—2. Turmeric (*Curcuma longa*)—1.

PULSES AND GRAINS.

Pigeon pea (*Cajanus cajan*)—Five strains from local sources and from Hawaii.

Rice bean (*Phaseolus calcaratus*)—1.

Bambara groundnut (*Voandzeia subterranea*)—1.

Lentil (*Lens esculenta*).

Hybrid maize (*Zea mays*)—Four types from Australia.

Poona pea (*Vigna unguiculata*) from Australia.

VEGETABLES.

Sixteen varieties of temperate and subtropical vegetable seed from Cyprus were received and sent to Principal Agricultural Station for trial and observation.

FIBRE PLANTS.

Jute (*Corchorus* spp.).—Two species.

Cotton (*Gossypium* sp.)—One variety.

Paper mulberry (*Broussonetia papyrifera*)—One variety, and Pandanus (*P. tectorius*).

BEVERAGES.

Cacao (*Theobroma cacao*).—Three introductions, including four plants of the Trinidad selection, I.C.S.—7, received from Kew Gardens, and seeds of high yielding and disease resistant hybrid (Forastero and Criollo) from Western Samoa, var. Lafi No. 7.

FRUITS AND NUTS.

Bananas and plantains (Musa spp.), including Soaqa (*M. fehi*) and *M. acuminata* ;

Pawpaws (*Carica papaya*)—Four varieties from Queensland and Hawaii, including Solo, Bettina and Peterson.

Summer fruits (apple, apricot, peach, greengage, plum and mulberry)—two of each introduced for trial at Navai.

Olives—two varieties, "Lucca" and "Fomo".

Breadfruit (*Artocarpus incisa*)—1.

Queensland Nut (*Macadamia ternifolia*)—1.

Avocado (*Persea americana*) vars. Haley, Nabal and Panchoy from Hawaii.

Fruit salad plant (*Monstera deliciosa*).

Orange (*Citrus sinensis*)—Rotuman oranges.

Pecan nut (*Carya pecan*) from Australia.

DRUGS AND INSECTICIDES.

Derris trifoliata, D. malaccensis and *D. elliptica* vars.

Tobacco (*Nicotiana tabacum*) vars. White Orinoco, Hicks, 400, Cash.

Yaqona (*Piper methysticum*) var. Qereqere.

OIL PLANTS.

Coconut (*Cocos nucifera*) var. Coconino, a dwarf variety from Phillipines, received via Hawaii.

Sunflower (*Helianthus annuus*) var. Giant Russian.

MISCELLANEOUS.

In addition to the above, seeds of a large number of forest timber trees (19) and ornamental trees and plants (20) were received and established or distributed to the Forestry Department. Those included Pines (*Pinus merkusii* and *P. Khasya*) from Indo China, ironwood (*Casuarina cristata*, cedar (*Cedrela australis*) and five species of *Eucalyptus* from Australia. Another interesting addition to the collection was the Fijian cinnamon or "Macou" (*Cinnamomum pedatinervium*).

ENTOMOLOGY . . .

PREMATURE NUTFALL ON TAVEUNI

BY H. W. SIMMONDS, O.B.E., LATE GOVERNMENT ENTOMOLOGIST

As instructed by you I left Suva on June 19th and proceeded to Taveuni to investigate reports which had been received of premature fall of coconuts on that island. I arrived at Waiyevo at 3.30 p.m. on Friday the 22nd and visited Soqulu and Vuna on Saturday 23rd and Thursday 28th. Mua was visited on Sunday 24th and Tuesday 26th whilst the 25th took me to Nalele and Buketa, the 27th to Quatevula and the 29th to Naselesele and the north end. Fine weather was experienced during this period but I was much handicapped by the fact that the Laboratory Assistant, Phillip, injured his ankle on the voyage and was unable to accompany me or climb, thus making me dependent upon raw climbers, who found it difficult to understand what was required.

PREMATURE FALL.

Generally speaking the heads of nuts now on the palms (and following the 1949 hurricane) are exceptionally heavy and it seems probable that it is the inability of the trees to feed these and the new nuts coming on which has led to a considerable fall of small nuts. This has been most marked in the central, drier portion of the island. Undoubtedly here the follow on will be light compared to the yield during the next few months. However, other factors have been at work, less so now than a few months back and two distinct periods of fall were noted.

First the small nuts, egg size and smaller, noted above and secondly, large nuts about two months prior to reaching maturity.

Taking the second class first, fully 50 per cent of this loss was undoubtedly due to rats and this type of loss occurred in all parts.

A second considerable loss of these nearly mature nuts was taking place in the heavy guava areas, high up at the back of the estates in blocks subject to heavy rainfall. So far as could be seen these nuts had already rotted on the palm, sometimes as much as half the coir being affected prior to the nut falling. No definite agency could be associated with this rot, although *Diacalandra taitensis* was always present in the stem of the spike. The main factor seems to be the heavy growth of guava, often as high as the palms and the misty, rainy altitude so that the soil was always wet. Where the guava had been cleared, a little lower, I was informed that the condition had greatly improved and certainly this type of fall was no longer marked.

There were, however, complaints of fall at this stage on an estate lower down (again said to have been much worse some time back). Here rats were undoubtedly the chief agency, but a certain amount was associated with attacks by *Diacalandra*.

It is difficult to evaluate the damage due to this beetle. In some cases a definite rot follows its borings, due to the entrance of fungi, but in others a stem will be attacked and yet mature its nuts, whilst again, in others heavy fall had taken place and no attack was visible.

EARLY FALL (TYPE NUMBER 1).

It was this type of fall which was causing so much anxiety on one estate, the nuts falling when about the size of a hen's egg or smaller. The palms on this estate were, however, carrying particularly heavy heads at the moment and a good deal of this early fall would be sheer inability to mature all that had set. It does, however, mean that the follow on crop is going to be short.

Other factors were, however, present, one being the incidence of the moth *Acritocera negligens*, which on several trees had destroyed whole spikes, as many as eight exit holes being present in the sheath, apart from those which fell to the ground after the spathe had opened. In one unopened spathe carrying only three female buds, one had

been eaten and the other two damaged by the larvæ of this moth, whilst on several trees the two or three successive spikes had been so gummed up by this agency that they had set no nuts and were in a filthy condition. There were also some spikes which seemed not to have set any nuts, whilst a curious condition was observed here and elsewhere in which a number of nuts had set but only one or possibly two developed.

In conclusion it seemed to me that, whilst no new agency could be found causing the trouble, there was an undoubted extra heavy fall due to a number of causes, some of which, such as *Acritocera* and *Diacalandra* were abnormally severe.

OTHER INSECTS ATTACKING TME PALMS.

Two other agencies, always present, but which by destroying the foliage, must materially affect the yield of copra in Fiji, are the Phasmid, *Græffea cocophagus* and the moth *Agonoxena argaula*. Both of these are universal and the former apt to increase seriously locally even to the extent of killing the palm. *Tirathaba* did not come under my observation, principally because I was not cutting the spathes in the right stage. *Aspidiotus destructor* was not observed upon palms, but was heavily present upon Avocado, despite the presence of the lady bird *Cryptognatha nodiceps* and the parasite *Aphytis chrysomphali*. The green scale, *Coccus viridis* was heavily attacking Liberian coffee at one place.

BUD ROT.

This was almost confined to the Malayan Dwarfs, which seem to be particularly susceptible. In one block it looks as if all the palms on the central ridge will be killed by this agency although only one of the odd tall palms growing amongst them was affected. One point here is that these palms seem to have been planted far too closely, causing them to run up, but throughout Fiji the tendency has, in my opinion, been to plant coconuts too closely.

Ashby showed that, in the West Indies, the primary lesion in Bud rot was due to invasion by the fungus *Phytophthora faberi*, followed by *Baccilus coli*. The same seems to be the case here, since, in stripping an affected palm from the oldest leaves to the central rot some years ago, I came upon a second primary lesion, which, when cut out and sent to London, was found to contain the mycelium of a fungus similar to *P. faberi*. These outbreaks of bud rot generally seem to follow hurricanes and are probably due to the straining of the foliage exposing the softer tissues and thus allowing the entrance of the primary fungus.

WEEDS.

During the depression years and owing to the shortage of labour during the war period, certain weeds have spread badly, chief of these being lantana and guava and, more recently, mint weed. In the higher back portion guava reaches the tops of many of the palms whilst in the old Liberian coffee block, which I remember as an open, grazing field, it is now fifteen or more feet high.

I tried to ascertain the costs of clearing such areas and obtained the following estimates and actual costs. In guava the method which seems to have proved most successful, is to cut the big stuff about four feet from the ground and remove the young growth two or three times. This costs about two pounds per acre or a little more.

Lantana has to be pulled out and a block of two hundred acres cost £940 for first weeding, £530 the second and estimated that a further hundred will have to be spent upon it i.e. about £7 10s. 0d. per acre.

SUGGESTIONS.

It is difficult to make any specific suggestions. With modern power it might be possible to dust the medium palms and drive out or kill the rats and Phasmids. In England I saw a Helicopter being used for this sort of work.

Diacalandra seems to call for investigation, but I do not think much can be done about *Acritocera* unless one could cultivate below the palms as the larva falls to the ground

to pupate. I would, however, like to see other crops than palms being grown.*

FLIES AND MOSQUITOES.

Both these dangerous pests were in appalling numbers almost everywhere and made life at the Rest House, which is not proofed, a torment.

The dung burying beetle *Copris incertis* was very abundant but I was unable to find *Platylister chinensis* and suggest that a colony be forwarded. The mosquitoes are chiefly the day biting Aedes, the vectors of dengue, filariasis in humans and heart worm of dogs. They were particularly fierce at Waiyevo and in the guava country.

THANKS.

In conclusion I would like to express my deep appreciation of the welcome and hospitality extended to me by everyone whom I met on the island.

* If the oil could be extracted locally it would greatly reduce freight (52s. 6d. per ton to Suva) and the meal would be of value for feeding stock. Taveuni formerly supplied much meal to Suva.

I would like to see Arabian coffee grown instead of the Liberian now there, whilst cacao would do well if given wind breaks. Timber would be worthy of consideration if a sufficient area of the one species could be established. I have in mind *Swietenia macrophylla*, the large leafed Mahogany.

RHINOCEROS BEETLE CONTROL

We have much pleasure in publishing a letter from Mr. Douglas Eden, General Manager, New Zealand Reparation Estates, Western Samoa, to Mr. H. Simmonds, O.B.E., late Government Entomologist, Fiji, in which Mr. Eden records proof of the successful establishment of the Rhinoceros Beetle parasite, *Scolia ruficornis*.

This parasite was brought to Western Samoa from Zanzibar by Mr. Simmonds in 1945 and for three years it was not seen. It is now evident not only that *Scolia* has become established but that it is already exerting local control over the beetle.

The success of this introduction is not only of great importance to the coconut industry in Western Samoa but also to the industry in neighbouring territories, and especially to Fiji which is so closely linked with Samoa by sea and air services. The greater control that is exerted over this destructive pest in Samoa, the less chance there is of its accidental introduction to other territories.

—C.H.

NEW ZEALAND REPARATION ESTATES

Apia, Samoa,
25th July, 1951.

Dear Simmonds,

You will be pleased to learn that the *Scolia ruficornis* is back again at Central Group at the old compost heap in greater numbers than ever. This time the compost heap will be left strictly alone.

Sixteen adults were counted when I was there, 19/7/51, and Kelly informs me there were many more on a brighter day.

A single adult female was seen on our Faleata coconut estate.

The palms at the back of our Head Office, and at the rear of the Casino, are showing a vast improvement, presumably on account of the *Scolia* hatchings from Curry's sawmill and our own compost heaps at the back of the Casino servants' quarters. Young palms planted by our labourers have not been attacked at all round the Head Office labour lines at Sogi. A few years ago coconut palms planted there were wiped out by beetle attack.

The foregoing is very good news indeed and I think proves beyond doubt that *S. ruficornis* is now well established in Samoa.

With kind regards to you and Mrs. Simmonds.

Yours sincerely,

D. EDEN.

H. Simmonds Esq., O.B.E.,
Suva, Fiji.

VETERINARY . . .

PHENOTHIAZINE FOR WORM PARASITES IN HORSES

BY A. F. S. OHMAN, M.V.Sc., SENIOR VETERINARY OFFICER

Horses in Fiji are commonly affected with intestinal worms. The most damaging is the redworm (Strongyles). Young horses may be heavily infested with large roundworms (Ascaris equorum). Phenothiazine can be satisfactorily employed to remove both types of worms.

Phenothiazine is administered in the form of a powder and is effectively given in the feed in the following doses:—

Draught horses	1 oz.
Light draught and saddle horses ...	¾ ,,
Yearlings and ponies	⅔ ,,

At times, phenothiazine may prove unsafe for horses. To overcome this difficulty it is recommended that the dose be divided into two or three parts and one part given on successive days until the full dose has been administered.

Starvation prior to treatment is not necessary. Most horses consume the powder readily. The addition of a small quantity of molasses will make the drug quite palatable.

Feeding of bran mashes prior to treatment is recommended but if the bowels are normally free which is usual when animals are on green grass, it is not necessary.

The urine of treated animals may show a red colour when exposed to the air but this disappears after a few days.

Horses should be spelled for a few days after treatment and until the red colour of the urine disappears.

It is not sufficient to treat an odd animal of a mob. All horses in a mob should be treated. A second treatment may be required in a few months time.

Following treatment it is advantageous to run animals in a paddock which has not carried horses for a few months.

TETANUS

BY A. F. S. OHMAN, M.V.Sc., SENIOR VETERINARY OFFICER

Tetanus is an infectious disease occurring in all animals but especially the horse. Sheep and goats are more readily susceptible than cattle but dogs and cats are less so. Man is particularly susceptible.

The disease is characterised by spasms which affect the body muscles, head, neck, and limbs.

CAUSES.

The disease is caused by a bacillus or germ which is commonly found in garden soil, dust and particularly in manure. It is prevalent in old established horse stables and animal standings. The germ only grows in the absence of oxygen and for this reason, deep wounds and nail pricks, where the germs are further removed from the oxygen of the air, are more dangerous than superficial wounds.

The organism excretes a toxin (poison) which combines with the central nervous system causing the general tetanic spasms.

Tetanus commonly follows compound fractures, castrations, tail docking, injuries to the mouth, injuries to the genital passage (during foaling or calving) and, in the newborn, following infection through the navel cord.

SYMPTOMS.

In the HORSE the symptoms are, nervousness, muscular spasms, stiffness of the jaws, difficulty in mastication and swallowing, extended head, and the protrusion of the "haw" or third eyelid. The "haw"

flicks across the inner part of the eye. This symptom is particularly characteristic and occurs when the animal is disturbed or excited. A sharp clap of the hands will cause this movement. The muscles of the neck and spine become rigid and the legs are moved stiffly. When the animal is caused to swing it moves in a manner described as a " ship without a rudder ". The tail is usually held elevated, the head extended and the nostrils dilated. In acute cases the symptoms become rapidly aggravated, the jaws are completely locked, breathing becomes painful and the animal goes down to die in agony.

It is seldom that recovery occurs in horses.

In SHEEP the disease usually occurs in the acute form. The animal stands with feet apart and elevated head and tail. When down, the animal lies on its side with limbs extended and rigid and the head and neck thrown back. Mortality is usually 100 per cent.

The disease follows a similar course in GOATS.

In CATTLE the symptoms resemble the findings in horses but they are not so severe. Cattle finally fall and show violent convulsions. The mortality is high.

TREATMENT AND PREVENTION.

Immediately a wound is seen and particularly one of a deep seated punctured type it should be thoroughly washed and irrigated with a mild antiseptic solution e.g. dettol, carbolic or felsol.

Tetanus antitoxin may be usefully employed and this is administered with an hypodermic needle and syringe. This treatment is preventive rather than curative. It is claimed to be effective within a few hours and lasts for two or three weeks.

The most recent preventive treatment is the use of tetanus toxoid. This involves a subcutaneous inoculation which is repeated in approximately twelve months time. Lasting immunity to the disease is claimed with this inoculum.

PHENOTHIAZINE FOR THE TREATMENT OF WORMS IN CATTLE, GOATS AND SHEEP

BY A. F. S. OHMAN, M.V.Sc., SENIOR VETERINARY OFFICER

Ruminants, which include cattle, goats and sheep have a complicated system of digestion and have four stomachs. In the first three stomachs the process of preparing the food for digestion takes place. It is in the fourth stomach and in the small intestine that most of the absorption occurs. Because of this it is essential that these organs be preserved healthy and free from parasites.

The most harmful worm parasites of cattle, goats and sheep are found in the fourth stomach and in the small and large bowel.

In this Colony, serious losses from worm infestation are common. The important factors which govern the development and survival of worms on the pasture are warmth and moisture and these conditions are prevalent in Fiji. Overstocking also tends to accentuate the prevalence of worm parasites. Young animals are most commonly affected.

IMPORTANT SPECIES OF WORMS.

There are many different species of worms which infest cattle, goats and sheep. Some are of only minor importance and may be ignored. Those causing the most serious trouble are :—

1. *The Large Stomach Worm.*—This is a fairly large worm up to 1¼ inches in length and found in the fourth stomach. The female is spirally striped. This species is frequently called the " barber's pole " worm. In heavy infestations there may be tangled masses in the stomach.

2. *Small Intestinal Worm.*—These are small pinkish worms and up to $\frac{1}{2}$ inch in length and usually inhabit the first 25 feet or so of the small intestine. They are often difficult to see. They are best demonstrated by scraping the bowel wall and placing the mucous in a transparent glass dish and viewing against a black background.

3. *Hookworms.*—These are found in the first few feet of the small intestine and are whitish worms and up to an inch in length. The worm adheres to the wall of the intestine by a small number of teeth.

4. *Nodule Worm.*—Nodule worm is also a short whitish worm which lies closely to the wall of the large bowel.

5. *Lungworms.*—These species are up to three inches and more in length, are found in the air tubes of the lungs and at times may seriously affect the air passages of calves and sheep.

METHOD OF INFESTATION.

Within the body of the host (cattle, goat or sheep) the female worm lays eggs, which are passed out in the dung. With suitable temperature and moisture, a minute larval worm develops in the egg and it soon hatches. The larva lives on the soil and in the vegetation and is soon ready to infest the young animal. It crawls up blades of grass, wet with rain or dew and is swallowed when the animal grazes. The hookworm larva may also reach the host by boring through the skin. Once inside the host, in stomach, intestine or lungs, the larval worm develops into maturity.

SYMPTOMS.

The animal gradually falls in condition and diarrhœa develops. The membranes of the eyes and mouth lose the pinkish colour and become blanched and white. The coat becomes dry and "stary" and the animal is described as hidebound. The calf becomes pot bellied and a swelling may develop under the jaw ("bottle jaw"). Emaciation continues and the animal finally dies.

It is common for lungworm infestation to occur in combination with stomach worms and the presence of the lungworm is denoted by difficulty in breathing and frequent coughing.

TREATMENT.

Phenothiazine is effective not only against stomach and small intestinal worms but is the only drug which has an efficient action on the nodule worms of the large bowel.

Hookworms are more resistant to it than other worms but even these may be controlled using large doses of the drug.

Phenothiazine has no action on tapeworms but these parasites are, in general, of little consequence.

So far as cattle goats and sheep are concerned, phenothiazine is looked upon as the best drench yet discovered for the control of intestinal parasites.

If animals have been allowed to reach the stage where marked symptoms are evident they should be treated twice with phenothiazine at an interval of 10 to 14 days. Thereafter, it may be necessary to drench each two months.

Every young animal in an affected herd or flock should be treated and not only affected stock.

Many stock owners consider that the poor condition of animals during the winter is the result of poor pastures and they do not realise the big part worms play until their stock are visibly affected. Although infestation does take place in the winter time, the greatest damage is done during the summer months when suitable conditions of temperature and moisture prevail.

ADMINISTRATION OF PHENOTHIAZINE.

Phenothiazine is not soluble in water but can be suspended in water and given as a drench. The total amount required to treat the stock is weighed out and thoroughly crushed. It is preferably passed through a fine sieve e.g. a kitchen flour sifter.

Starvation is not necessary before or after drenching.

The drench may be given in a bottle, a funnel or by a special drenching gun. For the small farmer, a small bottle is satisfactory.

The mixture must be well stirred during drenching to prevent the phenothiazine sinking to the bottom of the receptacle.

Remember the phenothiazine is not dissolved in the water but is in suspension.

For some days after treatment the urine may be stained red. This is of little importance.

Reports have been made of some ill effects after the use of phenothiazine in which CATTLE develop an eye condition resembling blight. This soon disappears. However, it is advisable to place treated stock in shady paddocks for a few days.

DRENCHING OF CATTLE.

The dose rates of phenothiazine for CATTLE are :—

2— 4 months	½ oz.
4— 6 ,, ...	¾ ,,
6—12 ,, ...	1 ,,
12—18 ,, ...	1½ ,,
over 18 ,, ...	2 ,,

The material is best made up by mixing the drug in the proportions of 1 lb of phenothiazine to 16 fluid oz. of water i.e. 4/5 pint water. The dose rates of this mixture would be :—

2— 4 months ...	1 fluid oz.
4— 6 ,, ...	1½ ,, ,,
6—12 ,, ...	2 ,, ,,
12—18 ,, ...	3 ,, ,,
over 18 ,, ...	4 ,, ,,

DRENCHING OF GOATS AND SHEEP.

Council for Scientific and Industrial Research Organisation (Australia) pamphlet No. 13, sets out dosages of phenothiazine for SHEEP and these are recommended for the treatment of GOATS.

Weaners 4—8 months old (30 per lb phenothiazine).

Dose.	Amount of phenothiazine	Add water until mixture measures.
1 fluid oz.	1 lb	1½ pints

Young sheep and goats 8—12 months old (25 per lb phenothiazine).

Dose.	Amount of phenothiazine	Add water until mixture measures.
1 fluid oz.	1 lb	1¼ pints

Sheep, goats, fullgrown (20 per lb phenothiazine).

Dose.	Amount of phenothiazine	Add water until mixture measures.
2 fluid oz.	1 lb	2 pints

POINTS TO REMEMBER.

1. Drench with phenothiazine before it is too late.
2. Do not drench ewes or nannies within one week of lambing or kidding.
3. Make sure of the dose rates advised.
4. Practice rotational grazing.
5. Do not overstock.

" KENAF "

Inquiries have been received regarding the fibre plant " Kenaf " which is the subject of the following extract from the *Sugar Journal* dated June, 1949:—

The fibre is obtained from a variety of *Hibiscus* (*H. sabdariffa* var. *altissima*) and is therefore already well known in the Colony. It is known locally by its Indian name " Patwa " or " Petua " and is grown commonly in the dry districts in small areas for the production of fibre for home made farm ropes. It has been grown experimentally several times with good results for such a purpose, but nowhere in Fiji in any large area as an industrial crop. During the war years when sisal and manila ropes and cordage were unobtainable, " Petua " was much used as a substitute. It is easily handled and yields good crops under local conditions.

—B.E.V.P.

"KENAF", NEW FIBRE CROP

Kenaf, a fibre crop new to the Western Hemisphere, is now being grown successfully in Cuba and El Salvador as a result of collaborative work between agricultural scientists of the United States and Latin American countries, the U.S. Department of Agriculture said to-day.

The new source of fibre promises to be of unusual value, both commercially and strategically. It is an effective substitute for jute fibre (a principal source of cordage and bagging material), which normally is imported from India and Pakistan. Jute, during recent years, has been in increasingly short supply because of conditions in the producing areas of India and Pakistan, a major one being that more of their land is going into food crops.

With the expected commercialization of Kenaf, which is now in pilot plant production, several benefits will acrue to Western Hemisphere participants, according to the Office of Foreign Agricultural Relations which has been active in the development. One benefit is the greater security from having a fibre source close at hand. Another would be reflected in the additional opportunities for income in the kenaf producing countries. Cuba, for example, which uses around $20,000,000 worth of sugar bagging yearly, has found that the kenaf season dovetails nicely with the sugar season, giving new opportunities for employment during what otherwise would be slack periods.

Kenaf is a fast-growing fibre crop whose original home is India. It was selected for Western Hemisphere introduction after many other fibre crops had been studied and tested. It has been found fully competitive to the jute fibre in yield, cost and strength. Its seed yields an oil comparable to cotton seed oil. One commercial grower in Cuba harvested nearly 100 acres of kenaf in 1948 and sold the raw fibre to a manufacturer in the United States. Other growers in Cuba, Dominican Republic, Haiti, and Guatemala are expressing interest in kenaf, and other manufacturers in the United States are experimenting with it. Good markets are anticipated as the fibre gets into active production."

CANKER DISEASE OF CITRUS

The above most serious and infectious disease of citrus has been discovered to occur in Fiji and all officers are instructed to keep an immediate and continuous watch for any condition in citrus trees which may be caused by this disease. Any specimens should be forwarded in sealed packages with necessary field data enclosed.

This disease is regarded very seriously in other countries and eradication campaigns have been carried out against it in the U.S.A., Northern Australia, New Zealand and South Africa. Grapefruit are the most susceptible, followed by trifoliate orange and orange. Lemons are considered to be less susceptible but do take the disease and act as carriers. Locally the disease has been found on grapefruit, orange and wild lemon, in all cases in a destructive phase.

The disease attacks stems, leaves and fruit and the symptoms are as follows:—

(1) *On leaves*—on young leaves the first signs are small, yellow spots about the size of a pin-head. At a later stage a small spongy eruption occurs on the lower surface with the upper surface raised—the spots being either white or brown. A watery and greasy margin may develop around the spots and a kind of watery, yellow halo which shades off into the normal green of the leaf.

Old lesions on leaves become brown, corky, hard and lignified and are raised on *both* surfaces of the leaves.

(2) *On fruit*—the lesions are similar but lack the yellow halo—and the eruptions are crater-like and may coalesce to form irregular scabby areas.

(3) *On twigs and branches.*—lesions are common and easily distinguished on young twigs—similar in general appearance to those on the leaves but without a halo. On old stems lesions may be found on the older branches especially of the more susceptible varieties.

(4) The following rough tests have been recommended for the determination of canker disease:

(*a*) Canker lesions in leaves will be elevated and apparent to the touch on *both* surfaces ;

(*b*) Canker lesions have a glazed margin with an oily appearance surrounding the eruption;

(*c*) With a hand lens the craters can be seen even in young lesions.

(5) The common scab disease of citrus prevalent on wild lemons appears as a wart-like projection from *one* side of the leaf, usually with distortion and, in older lesions, without the yellow halo.

(6) *Factors favouring the disease.*—Optimum temperature of leaf infection 86° F. (range from 68° - 95° F.).

Free moisture (rain or dew) on surface or rapidly growing tissues for 20 minutes.

Young trees are more susceptible than old trees.

The disease is more prevalent in places subject to considerable wet weather.

(7) *Prevention*—

(*a*) Up-to-date the Department has endeavoured by quarantine measures to prevent the introduction of this disease.

(*b*) If the present outbreaks are proved to be local, eradication, coupled with strict quarantine of infected areas may be sufficient.

(*c*) Infected trees must be burned—infected properties quarantined and clothing and tools carefully disinfected.

(*d*) Domestic animals should be excluded from infected areas.

(*e*) Treatment by spraying with Bordeaux is considered an expensive and unreliable means of controlling the disease, and one which cannot be used locally—where the prompt eradication of the disease as soon as it appears is the only method to be followed.

—C.H.

COFFEE

There is a steady demand in Suva for good quality coffee beans. The three main business houses have been contacted and it would appear that the present annual requirements approximate 12 tons. The price offered is 3s. per lb.

Coffee is known to exist in most parts of the Colony and there should be no difficulty in developing the local market. It should be appreciated that the present demand is accentuated by the dollar shortage and that provided good quality beans are marketed a regular demand for Fijian coffee may result. The trade requires coffee beans.

PREPARATION.

There are two methods of preparing coffee for market: (1) the wet method (pulping), which produces parchment coffee, and (2)

the dry method. It is understood that the Suva firms would prefer to buy parchment coffee, though no doubt they would purchase hulled coffee also. The wet method is recommended.

Pulping.—The cherry should be picked red-ripe and prepared the same day. The skin and flesh is removed by squeezing the cherry in water. The beans are then removed from the water and fermented in a wooden box for about 48 hours, the test of completion of this process being to wash a handful of beans in water and to squeeze in the hand ; if they are free from stickiness they are ready for washing. The beans are then washed several times in clean water and dried in the sun. At this stage the beans are covered by the " parchment " skin. Flavour is improved by storage for two or three years, but the grower usually markets the coffee as soon as it is dried and bagged.

Small hand pulping machines can be purchased overseas (pre-war price £5) but at least two acres of bearing coffee needed to justify purchase.

Parchment coffee requires to be hulled (to remove the parchment skin) before roasting.

Hulling of Cherry.—In the dry process, the ripe cherries are dried in the sun until the whole cherry is brittle dry, and then hulled either in a large wooden mortar or by machine. A hand huller cost about £4 pre-war. Cherry takes much longer to dry than the pulped beans, and if not thoroughly dry there is difficulty in passing it through the machine. Dry hulling removes both cherry and parchment at the one operation.

—L.W.H.

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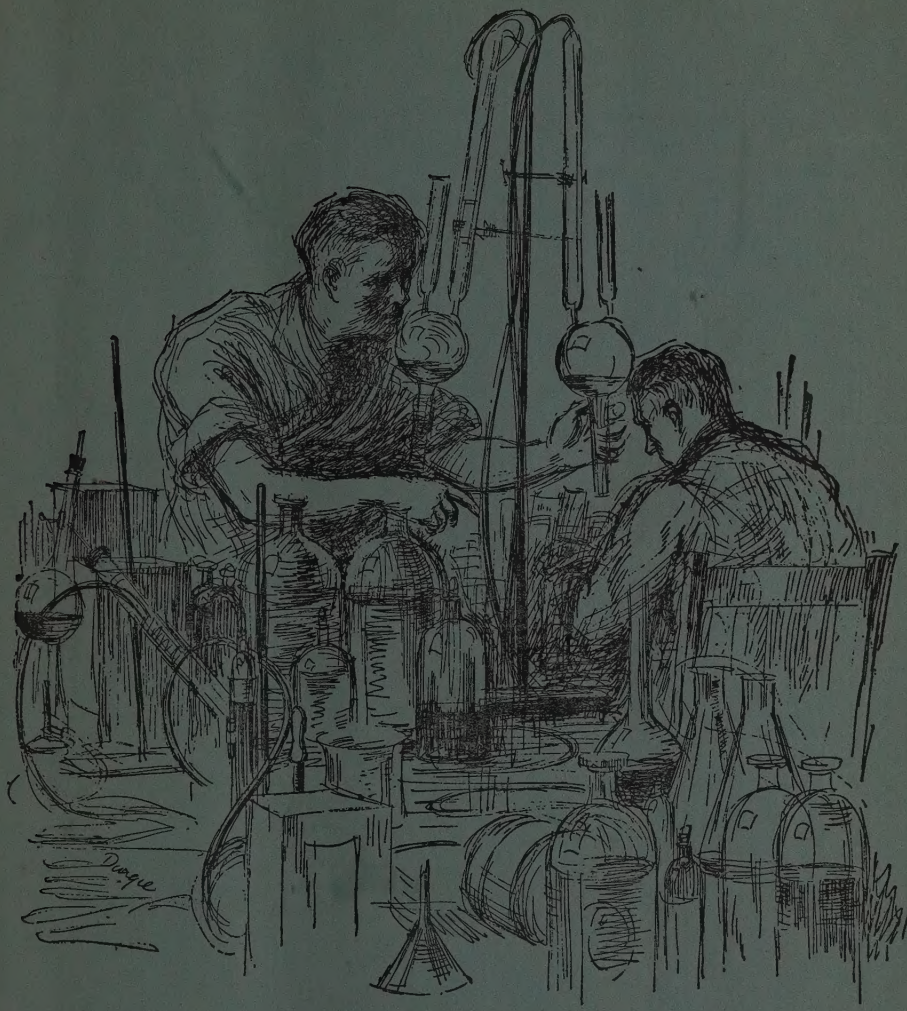

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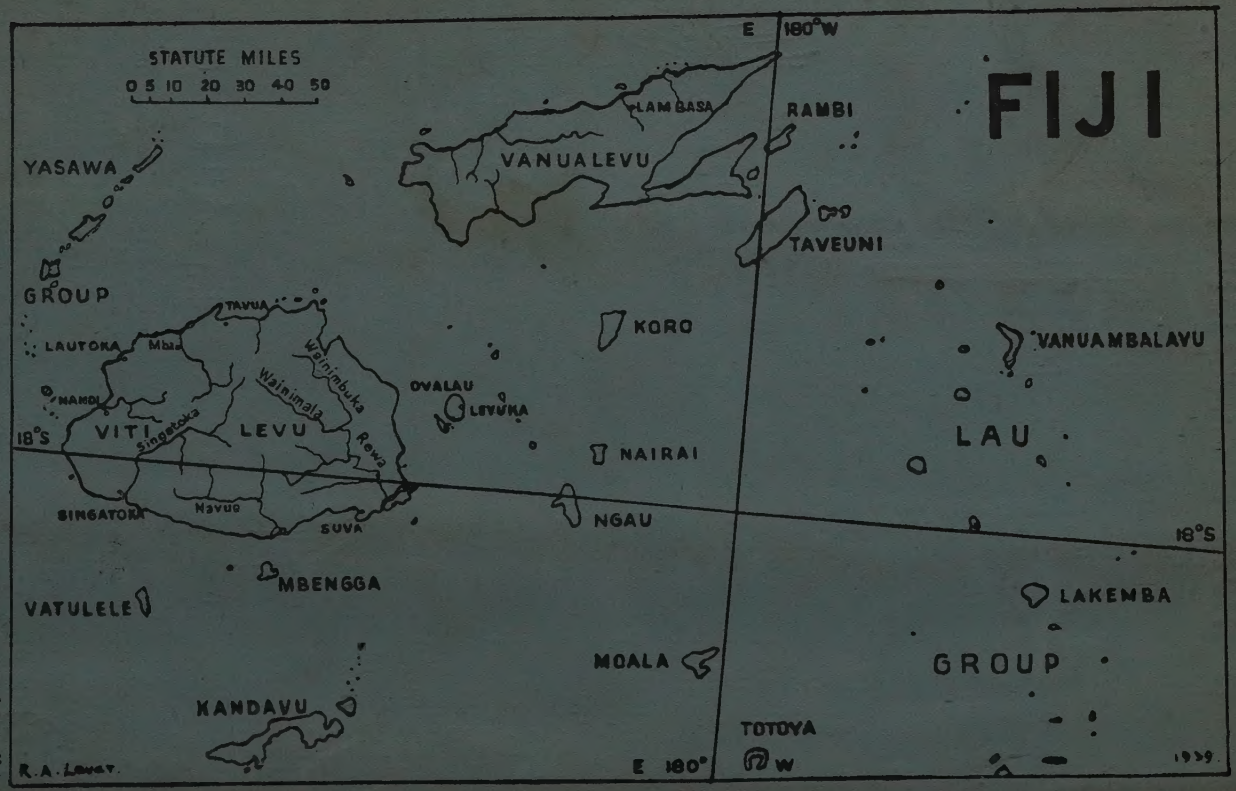

So as to include Kadavu and Totoya within the framework available the map has been rotated some 6° to the east.